



SN 1987A in the Large Magellanic Cloud

Space Infrared Telescope Facility (SIRTF)

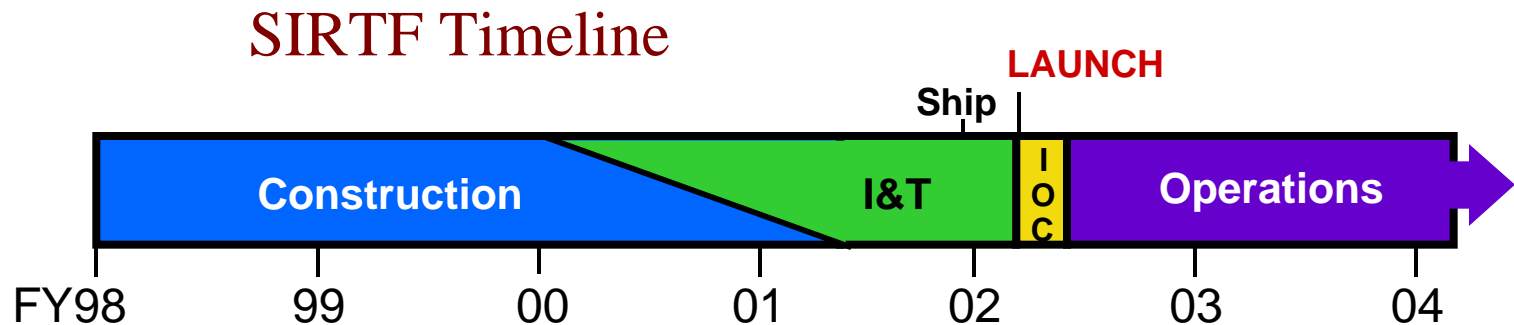
Presented by

Michael Werner
Project Scientist



Three Major Questions for SIRTF

1. How Common are Planetary Systems?
 - Requires the SIRTF telescope to be cold
2. How Much of the Star Formation History of the Universe is Hidden in the Infrared?
 - Requires broad wavelength coverage, large area imaging arrays, and ~arcsec spatial resolution
3. What was the Composition of the Forming Solar System?
 - Requires sensitive spectroscopic instruments based on infrared detector arrays

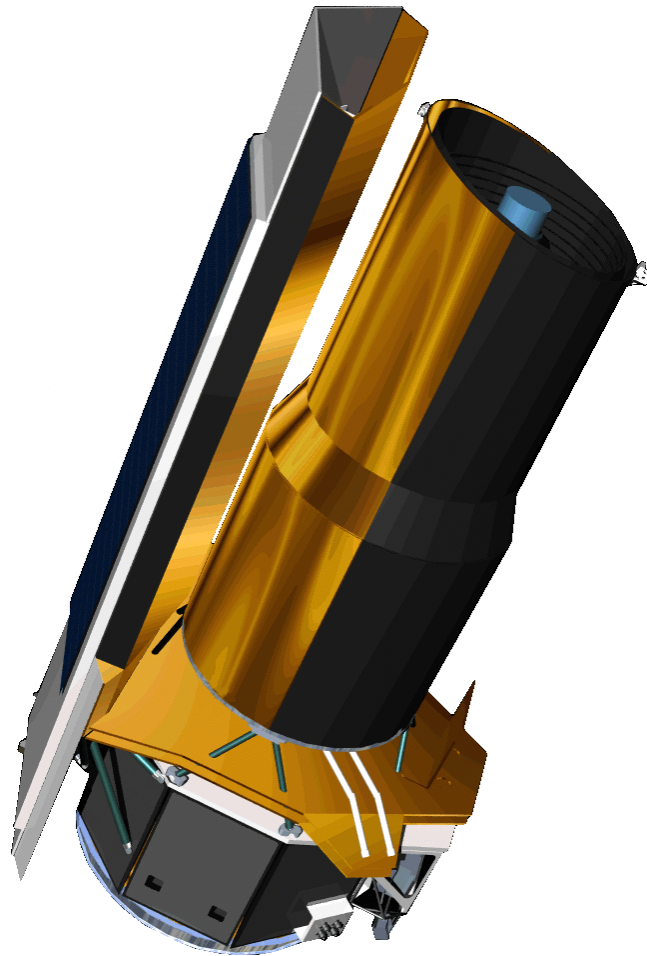


Space Infrared Telescope Facility

Space Infrared Telescope Facility

SIRTF

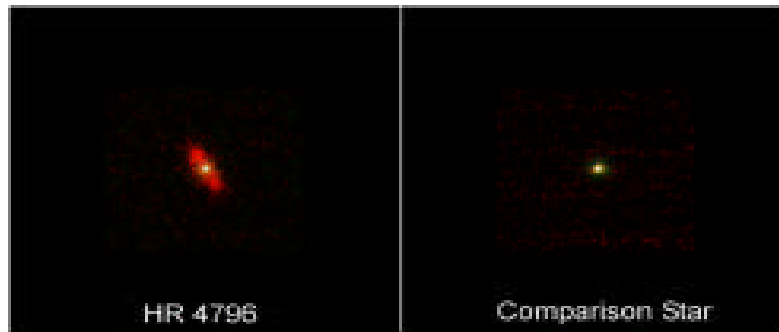
A NASA
Origins
Mission



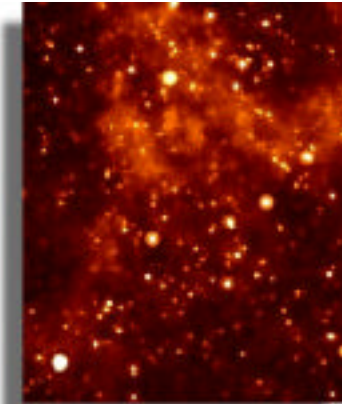
- **Infrared Great Observatory**
 - Background Limited Performance
3-180 μ m
 - 85 cm f/12 Beryllium Telescope < 5.5K
 - 6.5 μ m Diffraction Limit
 - New Generation Detector Arrays
 - Three Focal Plane Instruments
 - Imaging/Photometry, 3-180 μ m
 - Spectroscopy, 5-40 μ m
 - Spectrophotometry, 50-100 μ m
 - >75% of observing time for the
General Scientific Community
 - 2.5 yr Lifetime/5 yr Goal
 - Launch in Dec. 2001 (Delta 7920H)
 - Solar Orbit
 - \$450 M Development Phase Cost Cap
- **A Major Element of NASA's
Origins Program**

The Uniqueness of the Infrared

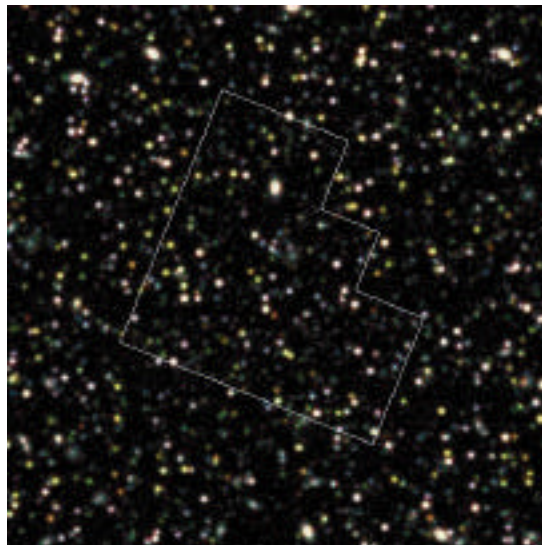
Infrared Observations Probe:



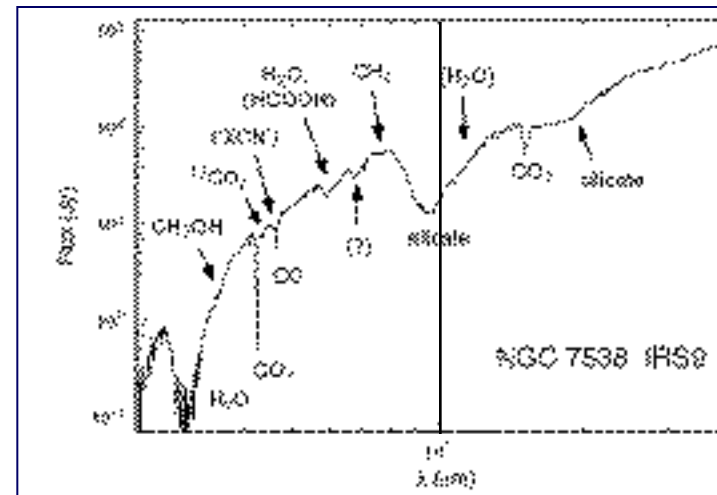
The Cold Universe



The Dusty Universe



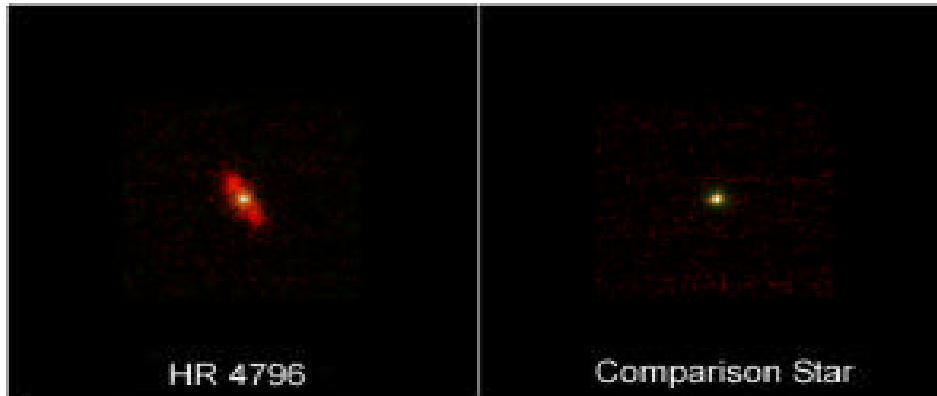
The Distant Universe



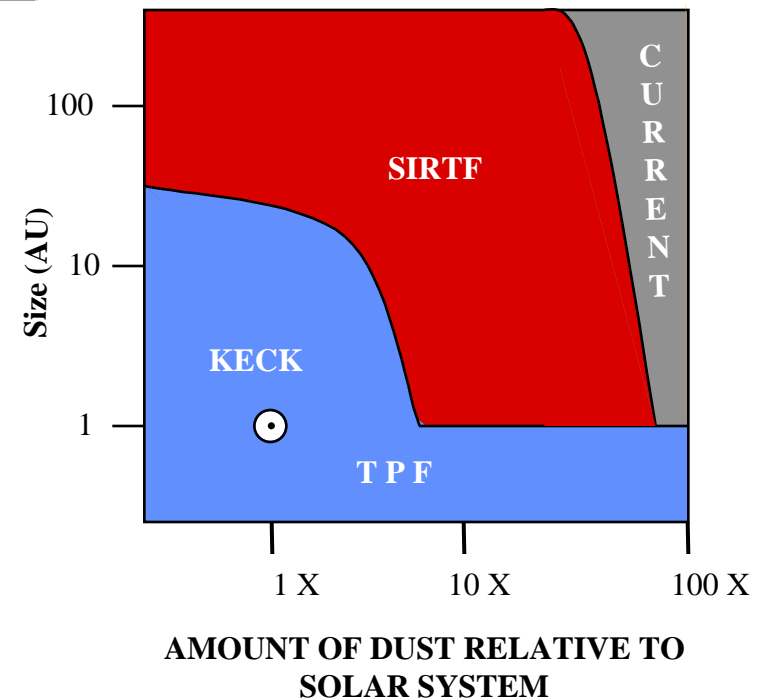
The Chemical Universe

How Common are Planetary Systems?

Space Infrared Telescope Facility



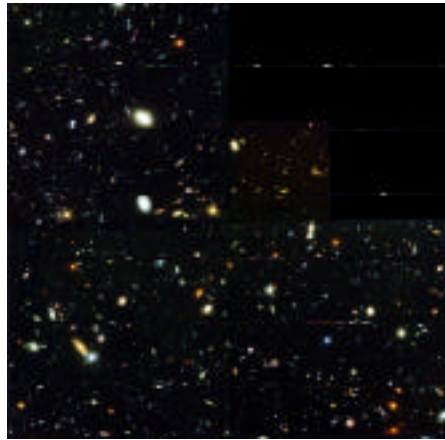
- Disks of cold dust around sun-like stars signal the presence of planetary systems
- Our Sun has a very thin disk – the zodiacal cloud
- SIRTf can study systems only a few times larger and/or dustier than our own solar system
- Keck Interferometer and TPF can extend these measurements to the solar system level



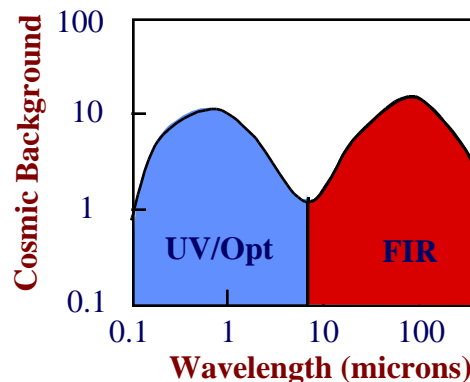
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How Much of the Star Formation History of the Universe is Hidden in the Infrared?

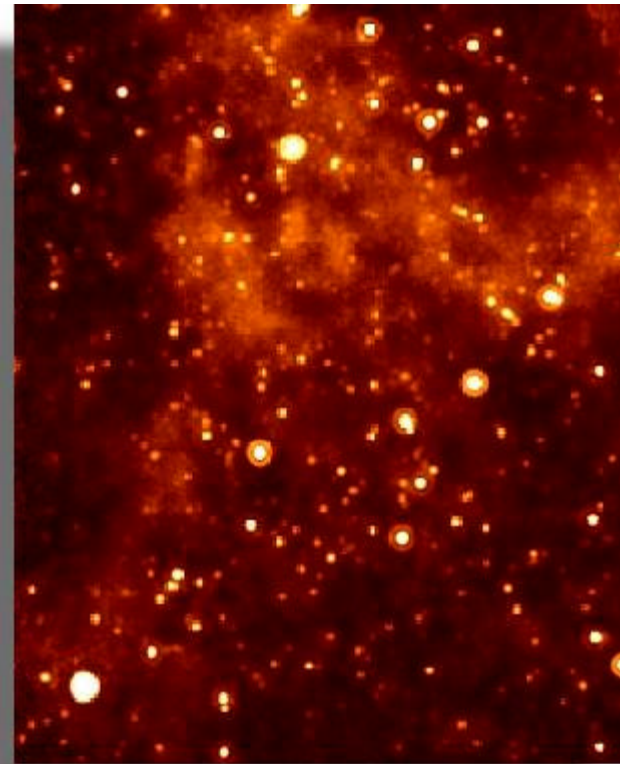
- The Energy Budget



The Hubble Deep Field allowed the UV/optical energy content of the Universe to be estimated



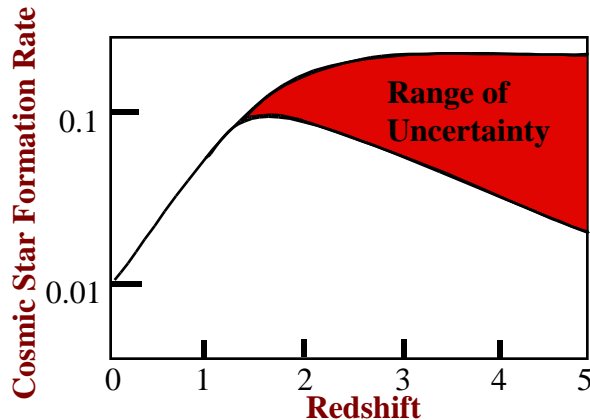
COBE discovered as much energy in the far infrared background as is emitted by stars in UV and optical light



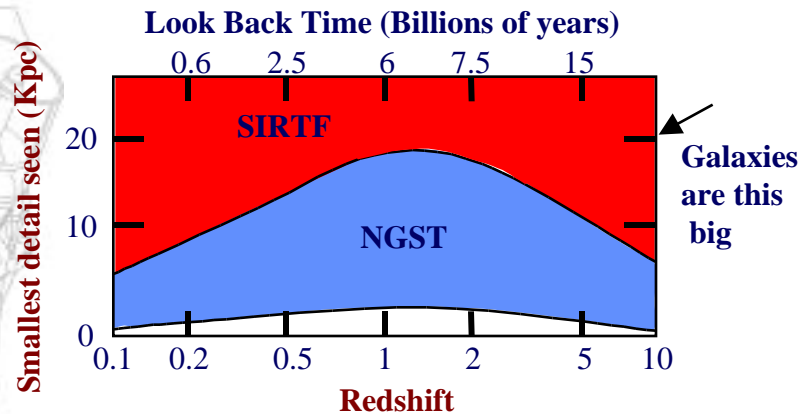
SIRTF can resolve the far infrared background and show whether it is due to dust-hidden star formation

How Much of the Star Formation History of the Universe is Hidden in the Infrared? (Cont'd)

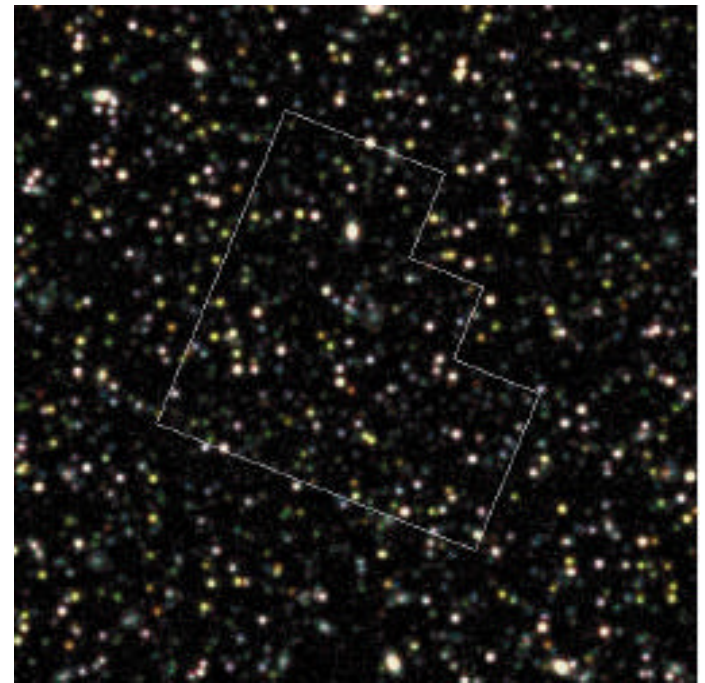
• Counting the Stars



HST measured the rate of dust-free star formation in distant galaxies, seen when the Universe was a small fraction of its current size and age.



NGST will reveal the structure of star-forming galaxies in the early Universe.



SIRTF will also measure how many stars have *previously* formed in these galaxies, further reducing the uncertainty in the star formation history of the Universe.

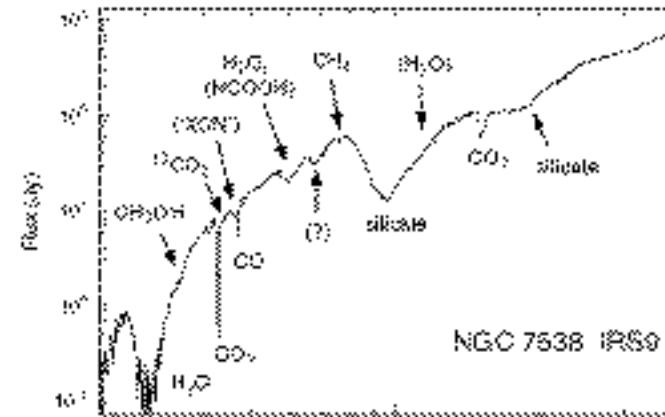
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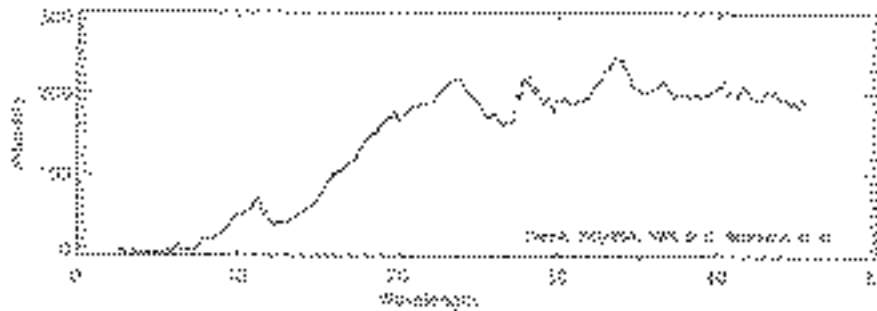


What was the Composition of the Forming Solar System?

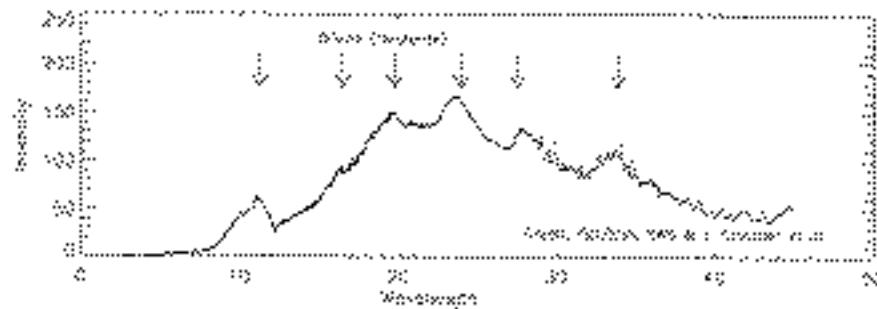
- Interstellar, circumstellar, and solar system, matter is chemically rich and diverse
- SIRTF spectra can identify icy and mineral materials around young stars which may harbor forming planets
- Higher resolution spectra from SOFIA and NGST can study gas phase species in these objects



Wavelength Ices in star forming clouds include organic material



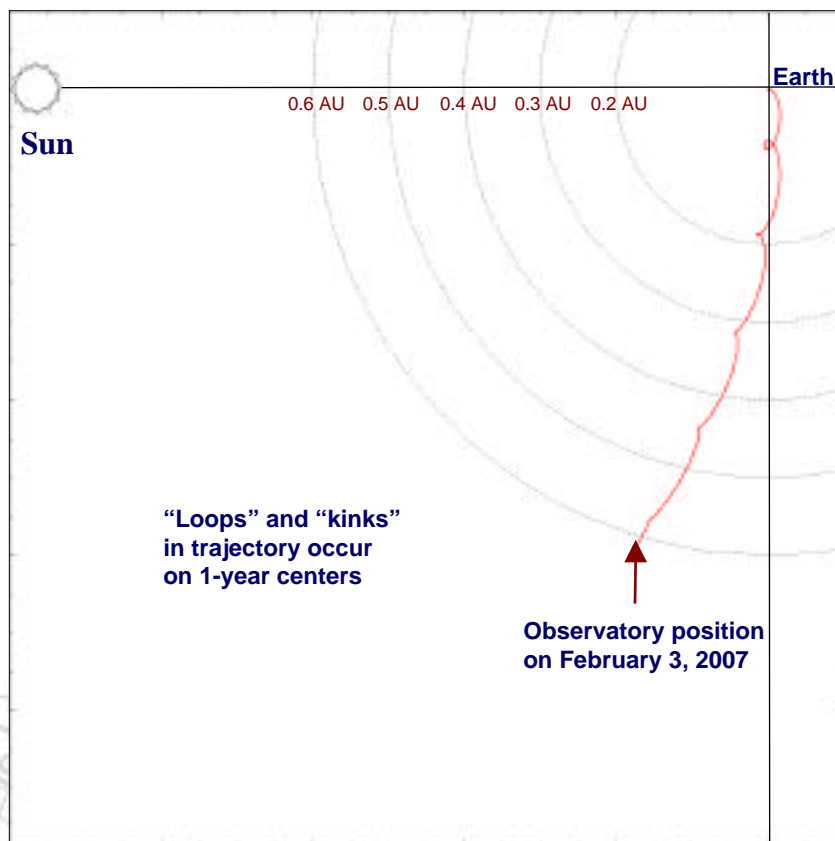
Stellar Dust Cloud (HD 100546)



Comet Hale-Bopp

Minerals around young stars are similar to these in our solar system

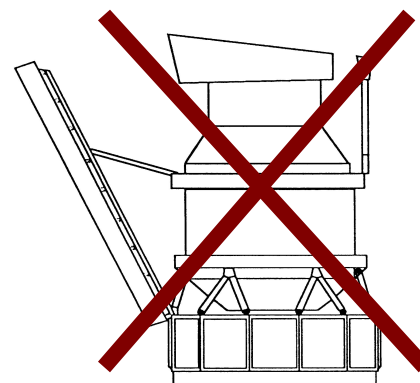
SIRTF – Enabling Innovations



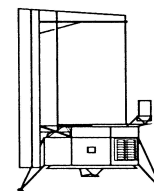
SIRTF Orbits the Sun

Innovative solar orbit enables
innovative warm launch
architecture – achieves same
lifetime with much less mass

**Titan-SIRTF
(1990)**



**Delta-SIRTF
(1995-)**

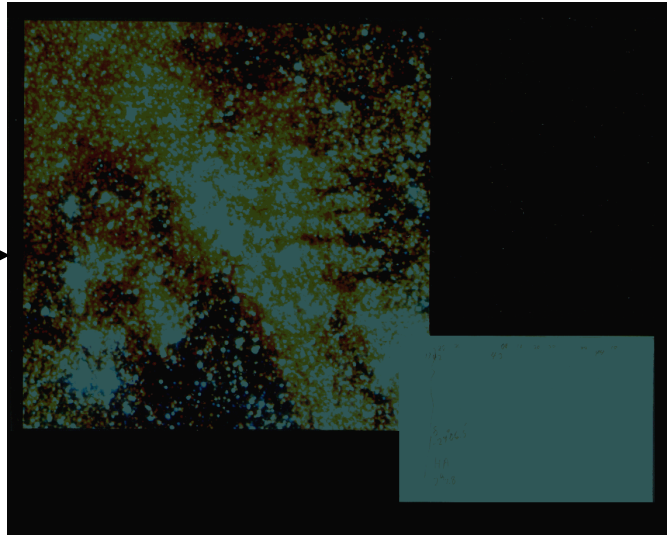


Launch Mass	5700 kg	905 kg
Liquid Helium Volume	3800 liters	360 liters
Telescope Aperture	92 cm	85 cm
Planned Lifetime	5 year	5 year

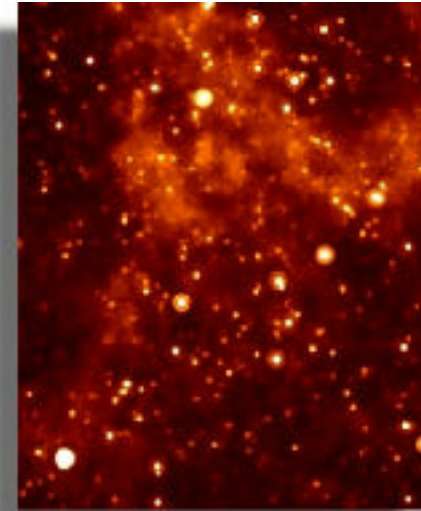
The Infrared Array Revolution

SIRTF instruments rely on infrared detector arrays with hundreds of thousands of pixels

1994 →

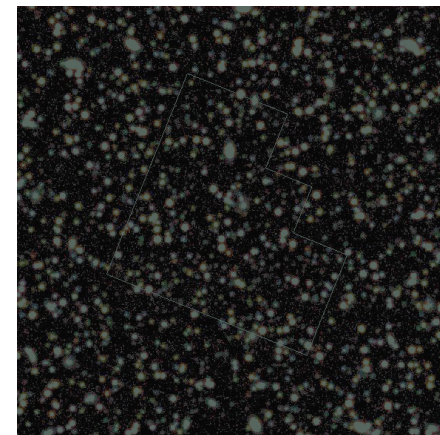
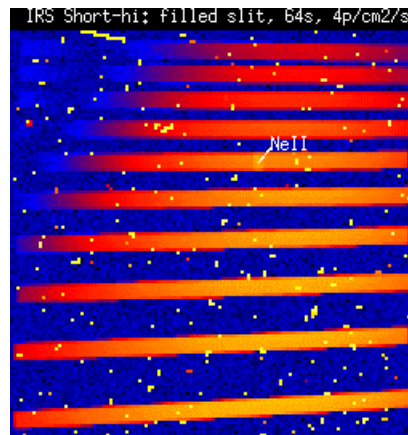


← 1964



The Galactic Center

Simulated images from SIRTF cameras (above and below) and spectrograph (below left) show how SIRTF will use this technology



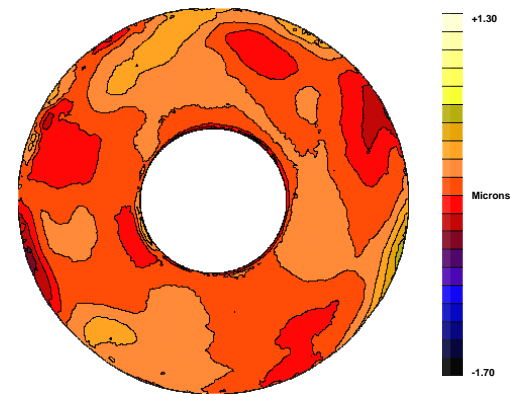
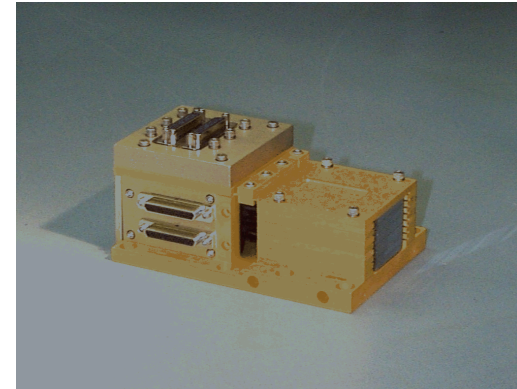
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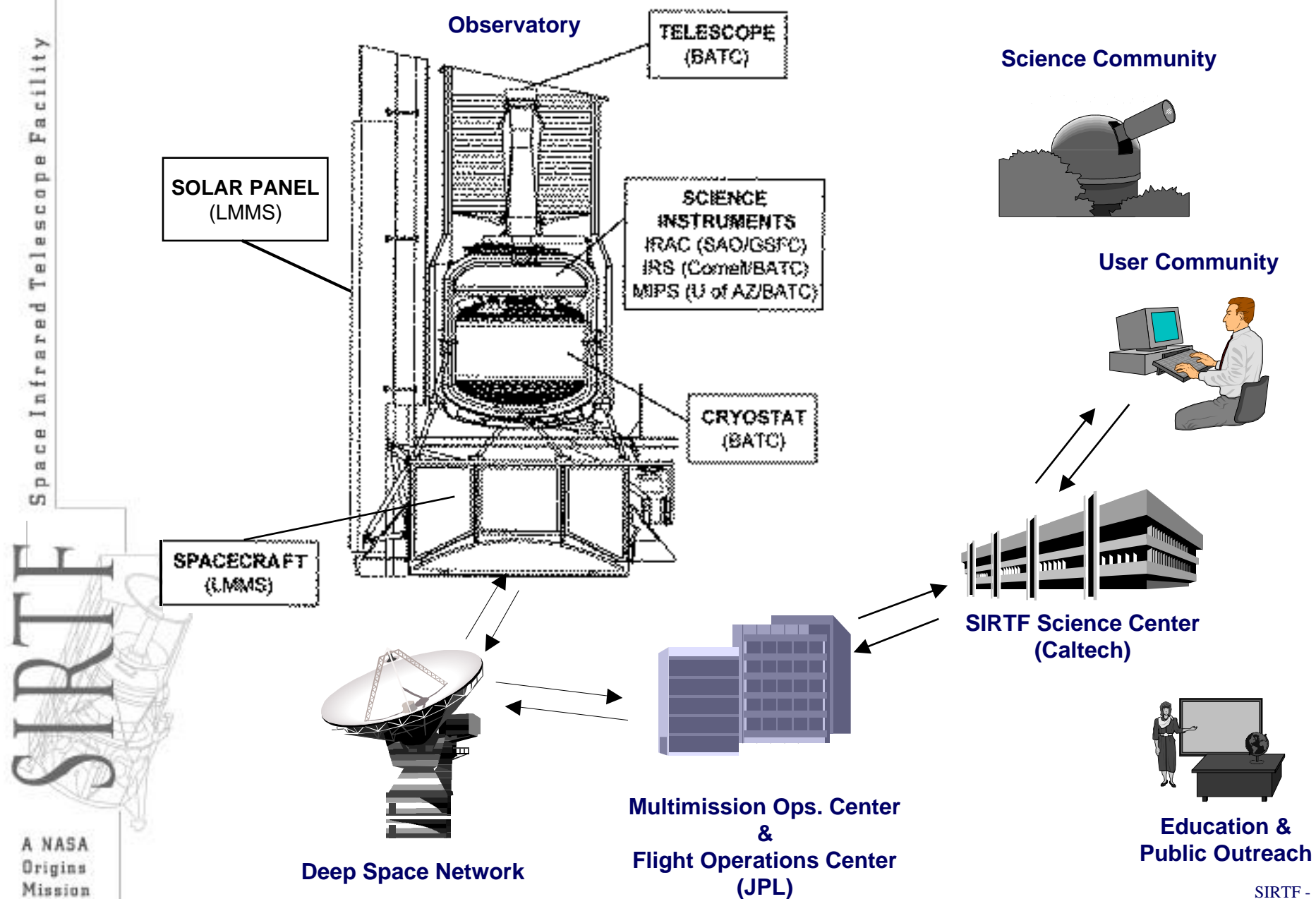
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SIRTF Development Is Meeting Key Milestones

- Flight detector fabrication/procurement underway
- Primary mirror tested cold: final polishing underway
- Analysis of cryogenic system predicts lifetime in excess of 5-yr goal



SIRTF System Architecture and Team Members



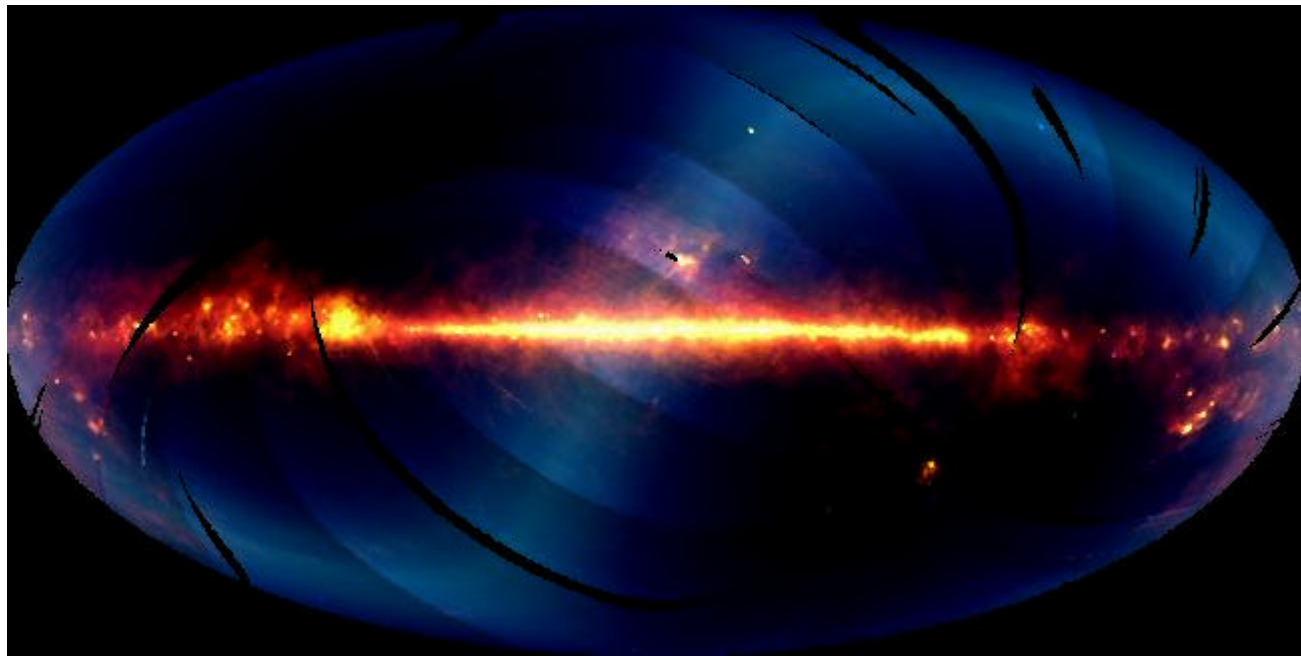
SIRTF – An Observatory for the Community

- Over 75% of SIRTF observing time will be awarded to the general scientific community via peer review. Steps taken to prepare the community include:
 - SIRTF Surveys Conference, 6/98
 - SIRTF Speakers' Bureau - talks to ~30 astronomy departments
 - Prototype observation planning tools available on the WEB
 - Leading up to Calls for Proposals:
 - Legacy Science Program - 7/00
 - General Observer Program - 10/01



SIRTF Legacy Science Program (LSP)

- The LSP is a novel approach to engaging the community in large-scale SIRTF investigations
 - Teams competitively selected
 - Data made quickly available to all for SIRTF follow-on
 - Legacy programs will create large, coherent data bases, following tradition of earlier infrared programs



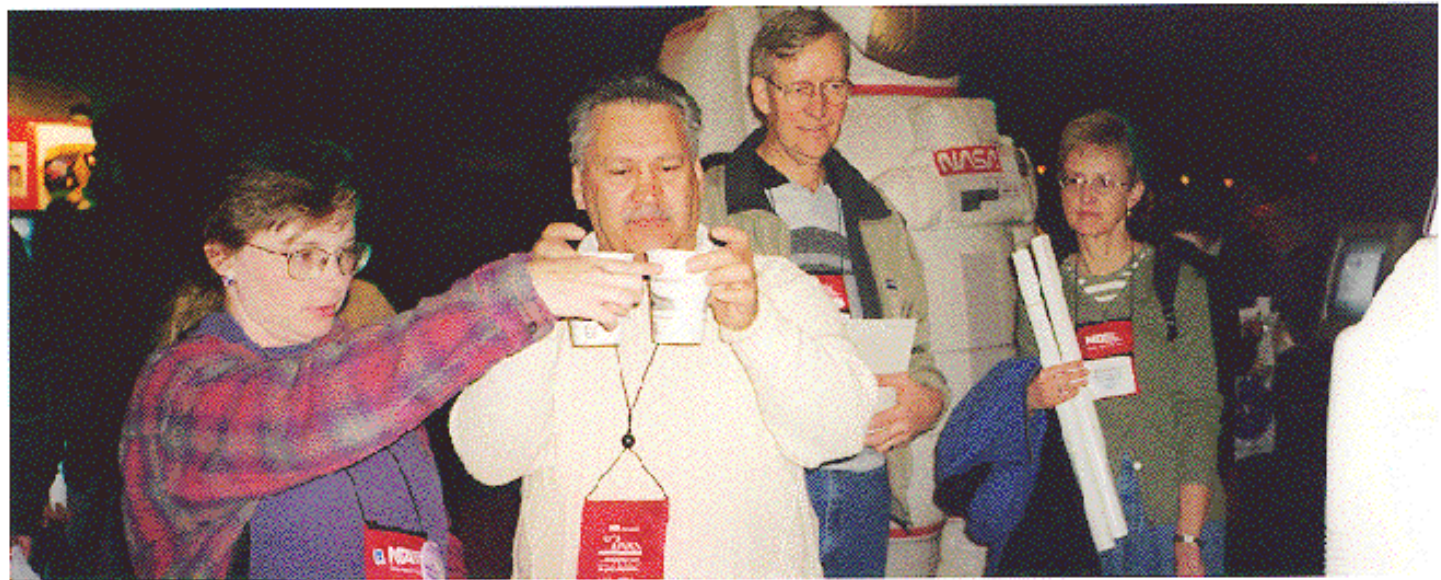
IRAS ALL SKY INFRARED IMAGE (1983)

SIRTF Education & Public Outreach in Action

Space Infrared Telescope Facility



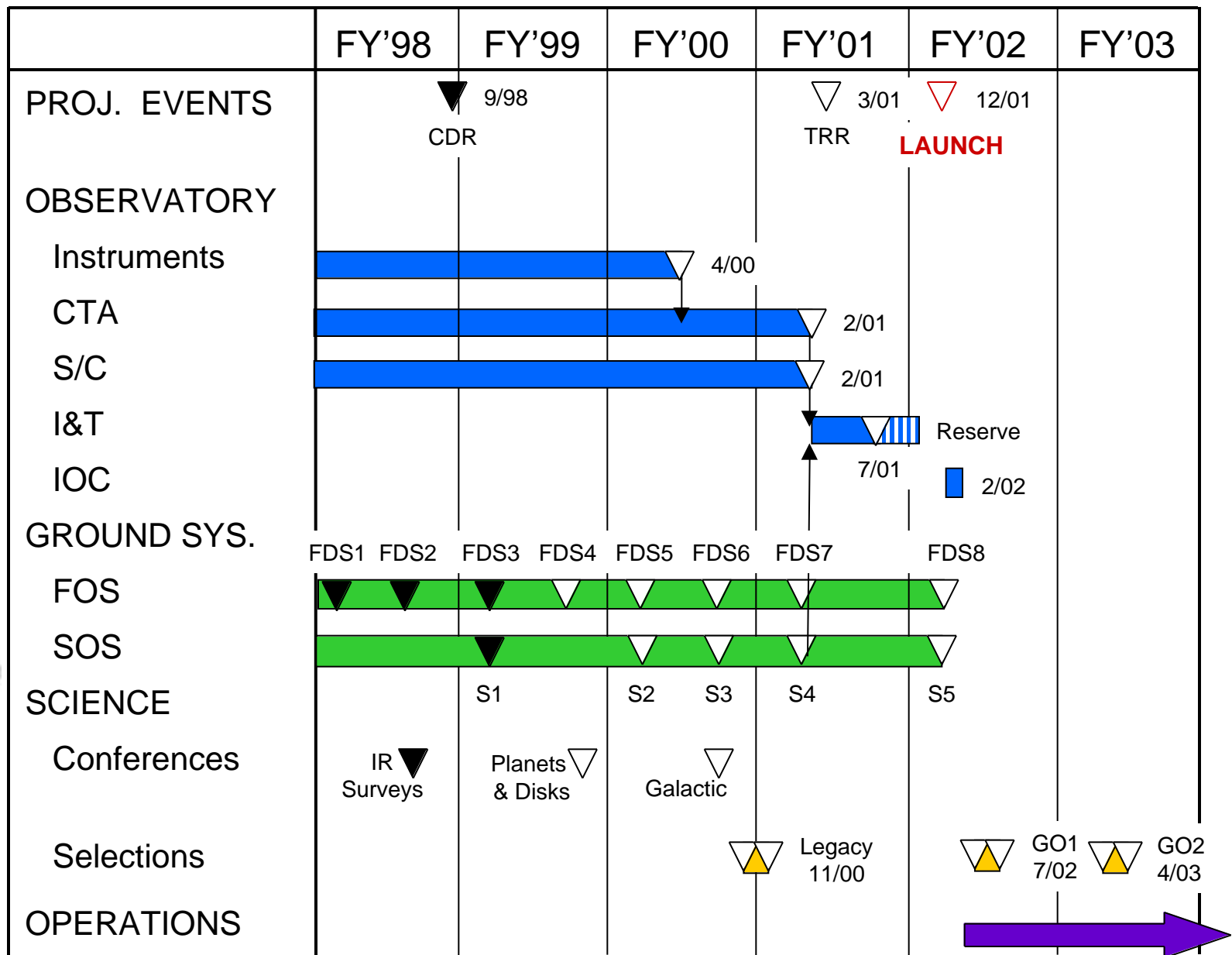
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SIRTF Education & Public Outreach

- Educational module 1 (The Nature of Light) under development by U. Arizona and LA middle schools
- Module 2 (More Than the Eye Can See) under development at SIRTF Science Center
- Web-based “Infrared Tutorial” receiving awards
 - 60,000 external “hits” monthly
{<http://www.ipac.caltech.edu/Outreach/Edu/>}
- Invited Talks @ AAPT National Convention (Anaheim, 1/99)
- Products Produced Recently
 - Brochure, Pocket Guide, Poster (all SIRTF)
 - NASA Lithograph (IR Astronomy)
 - 300,000 copies printed (including 100,000 for Hq Education)

SIRTF Schedule

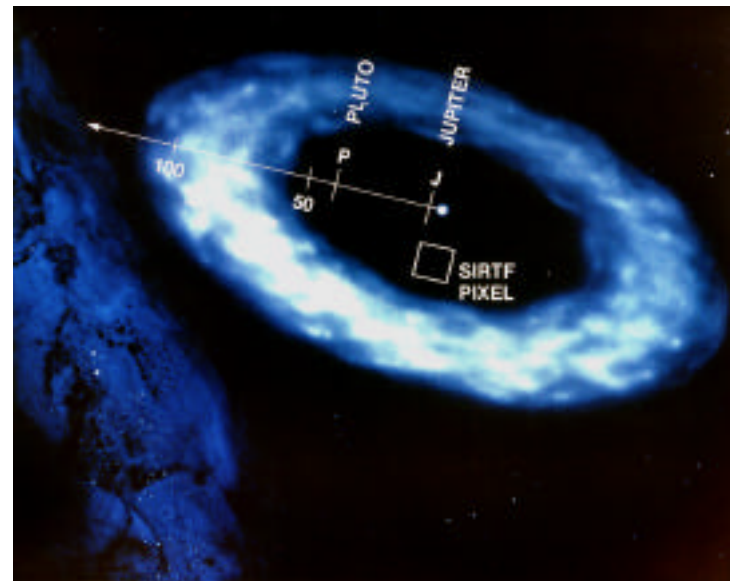




SIRTF – A Major Element of the Origins Program

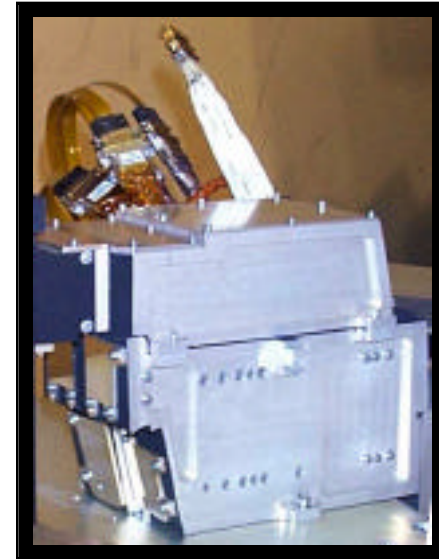
- SIRTF will provide key scientific results to the Origins program. SIRTF will:
 - survey nearby stars for dust disks as faint as that in our own Solar System
 - study star formation in normal galaxies to beyond $z = 3$
 - probe dust-obscured ultraluminous galaxies to beyond $z = 5$
- SIRTF demonstrates key technologies for follow-on Origins missions
 - lightweight cryogenic optics
 - high performance passive cooling
 - state-of-the-art infrared detectors
 - deep space operations

**SIRTF can image solar system
like dust distributions
around nearby stars**



Highlights for the Coming Year

- Construction of SIRTf continues apace:
 - Completion of build-up of spacecraft structure – 5/99
 - Completion of cryostat – 10/99
 - Instrument delivery for integration into telescope – 4/00
- Topical SIRTf Science Conferences – open to all:
 - Planetary Science and Debris Disks – 8/99
 - Galactic Astrophysics – 5/00
- Release of Legacy Science Call for Proposals – 7/00

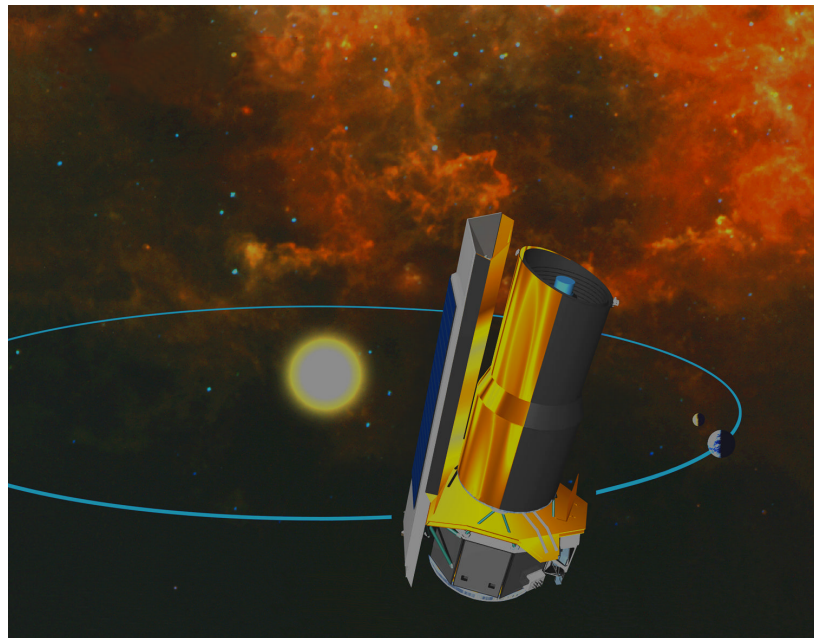


SIRTf flight spectrograph module



Three Things to Remember about SIRTf

- SIRTf is a major scientific and technical element of the Origins Program
- SIRTf construction is proceeding on schedule towards launch in December 2001 and a projected lifetime of more than 5 years
- The science community is mobilizing to respond to the SIRTf Legacy Science Opportunity



For more information about SIRTf, visit our web site:

<http://sirtf.caltech.edu/>

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